

Apodibius serventyi sp.nov., a new clawless water-bear [Invertebrata: Tardigrada] from Western Australia

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Manuscript received 18 June 1985; accepted 18 February 1986

Abstract

Apodibius serventyi sp.nov. is described on the basis of examination of 34 specimens obtained from three localities around Perth, Western Australia. A morphometric analysis of the specimens is complemented by light microscope and scanning electron microscope images. The systematic position of *Apodibius serventyi* sp.nov. within the Tardigrada is considered.

Introduction

The Tardigrada are small, multicellular animals between 50 μm and 1200 μm long, though rarely exceed 500 μm . They occupy the surface water films of mosses, liverworts, lichens, and some algae or the water-filled spaces in soil, marine and freshwater sand and sediments (Morgan and King 1976). In woodland litter they may inhabit the interstices of decomposing leaves, particularly willow, and some species exploit a range of herbivore dung (Morgan 1982). Utilizing this specialised range of habitats tardigrades can attain densities up to several millions per square metre in marine sand or on a moss encrusted roof (Morgan 1977). The group has a world-wide distribution (Ramazzotti and Maucei 1983).

There is an extensive literature on tardigrades dominated by studies from North America and European localities. Australia has been overlooked except for contributions by Richters (1908) who observed the ubiquitous *Macrobiotus hufelandi* (Schultze) at Katoomba in the Blue Mountains and Murray (1910) who recorded 31 species, several new to science, from New South Wales and Queensland. Murray noted that the Australian fauna was very localised and showed many peculiarities. There is every indication that recent research initiatives will confirm this contention.

In the course of studies on the Tardigrada of Western Australia the authors found 34 specimens of a clawless water-bear belonging to the recently described genus *Apodibius* Dastych, 1983. The specimens differed in several respects from the type species *Apodibius confusus* Dastych, the sole representative of the genus described to date. *A. confusus* had been described on the basis of three specimens extracted from mosses overlying soil in NW Poland (Dastych, 1983). The genus *Apodibius* differs distinctly from all known genera of Tardigrada in lacking any claw-like structures on all four pairs of legs.

Apodibius serventyi sp.nov.

Diagnosis: An *Apodibius* with three macroplacoids in the pharyngeal bulb.

Description of holotype: Length 355 μm . The body is hyaline and lacks pigmentation. Cuticle smooth and featureless. Eye spots present, positioned at about the level of the stylet supports (Fig. 1A). Mouth terminal

and surrounded by six low, hemispherical peribuccal lobes. Buccal apparatus of the *Macrobiotus* type with a well-developed strengthening bar (Fig. 1B). Buccal tube smooth and slightly curved downwards over the anterior third of its length. Buccal tube of uniform width (4 μm) over most of its length, widening at the bulb where the wall is also thicker. Pharyngeal bulb pear-shaped, 33 μm long x 28 μm broad, with the greatest width in the posterior third. Bulb with almost triangular apophysis 2.5 μm long overlying the end of the tube. Three macroplacoids, each a rod with well-rounded ends, 3, 3.5 and 4 μm long respectively. Macroplacoids close together, the first and second connected by a narrow neck which can be observed only under oil immersion by altering the plane of focus. Pharyngeal rods occupy the anterior two-thirds of the bulb. Microplacoid absent. Legs small and variably developed, 17, 35, 26, and 18 μm in length from first to fourth pairs (Fig. 1A). Each leg with a smooth outline except for low protuberances: one, 5 μm high, on each of the first pair of legs; three, 3, 7 and 3 μm high, on the second pair of legs; two, 6 μm high, on the third pair of legs; and two, 5 and 7 μm high on the fourth pair of legs. No claws or other sclerified structures (Figs 1C, D, E, F).

Description of paratypes: Length 188 μm to 430 μm . Body hyaline, lacking pigmentation. Eyespots generally absent; only observed in four out of 33 specimens. Mouth terminal or slightly sub-terminal and surrounded by six peribuccal lobes (Figs 2A, 3A, C). Anterior edge of mouth of some specimens circled by a narrow wreath of small elliptical thickenings which are only discerned with great difficulty. Buccal apparatus of the *Macrobiotus* type with well-developed strengthening bar. Stylets bellied out in the middle and arrangement of furca asymmetrical. Buccal tube smooth and often curved ventrally at the anterior end. Length of tube 8 to 13% of total body length. Dimensions of bulb variable, often a short pear shape with the greatest width across the posterior third, sometimes spherical or almost so, occasionally shorter than broad. Triangular apophysis and three macroplacoids, the latter rods with rounded ends. Macroplacoids of equal length, increasing in length from one to three, or the first or second may be longest. The first and second macroplacoids connected by a narrow neck. Microplacoid always absent.

First and fourth pairs of legs poorly developed, second and third pairs less so. Claws or other sclerified structures completely absent. Each leg usually with at least one low terminal protuberance, often two, sometimes three (Fig. 2B, 3B, 4).

The locomotion of one live specimen was noted prior to permanent slide preparation. The animal moved easily if sinuously through flocculent matter settled at the bottom of a petri dish. *Apodibius serventyi* sp. nov. traversed this material faster than clawed species also present in the sample; the latter reached for and held on to material in their progression and were slower in consequence. No eggs were found, although several specimens displayed a ventral genital pore (Fig. 3D).

Type locality: Moss from the vertical face of a limestone retaining wall by the walk-through aviary at South Perth Zoo (holotype and 26 paratypes). Moss growing in the cracks between paving slabs from a back garden at Woodlands, a northern suburb of Perth (two paratypes). Moss growing on soil from an island garden in an ornamental pool at the Cottesloe Civic Centre, a coastal suburb west of Perth (five paratypes, including a simplex individual).

Type repository: Western Australian Museum, Francis Street, Perth 6000, Western Australia.

Registration numbers are as follows:

WAM 86/356 Holotype on a SEM stub

WAM 86/349-53 Five paratypes on a microscope slide

WAM 86/354-5 Two paratypes on a SEM stub

We are pleased to name this species after the Australian naturalist Dr Dominic L. Serventy.

Table 1

Apodibius serventyi sp. nov.—measurements of type specimens.

Measurements (in μm)	Holotype	Paratype	
		Mean	SD
Body length	355	360	± 66
Tube length	32	35	± 4.7
Tube external diameter	4	4.5	± 0.7
Bulb length	33	36.8	± 5.5
Bulb width	28	35.7	± 6.2
Apophysis length	2.5	2.8	± 0.5
First macroplacoid length	3	4.2	± 1.3
Second macroplacoid length	3.5	4.2	± 0.7
Third macroplacoid length	4	4.7	± 1.0

Discussion

Dastych (1983) described the systematic position within the Eutardigrada of *Apodibius confusus* as unclear "because of the strong reduction of legs and above all, the complete lack of claws". The description of *Apodibius serventyi* sp. nov. while confirming the unique character of the genus has done little to extend our knowledge of systematic affinity.

Currently, there are two schools of thought on the importance of characters which are used to determine systematic arrangement within the Eutardigrada. Pilato (1969 a,b) proposed a classification in which claw structure predominated over bucco-pharyngeal apparatus. This system has gained widespread

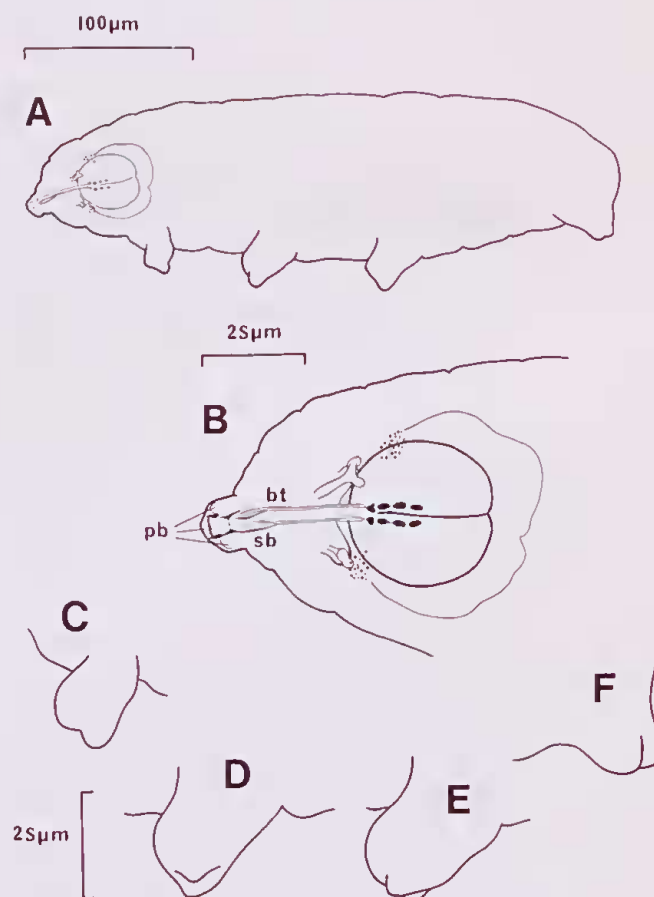


Figure 1.—*Apodibius serventyi* sp. nov. Holotype

A. Entire

B. Pharyngeal apparatus

bt buccal tube

pb peribuccal lobes

sb strengthening bar

C, D, E, F. Legs 1 to 4 respectively.

acceptance among tardigradologists. Recently, Schuster *et al.* (1980) devised a revision of the Eutardigrada in which the arrangement of the bucco-pharyngeal apparatus, and in particular the possession of a buccal tube support, is given increased prominence and new familial arrangements devised accordingly. This new arrangement has generated criticism, notably that of Bertolani (1981), who considers the subdivision into families proposed by Pilato (1969 a,b) more acceptable phylogenetically, and Pilato (1982) who, we believe, successfully re-appraises the justification for his original taxonomy with the addition of information on recently described genera and species.

Pilato (1982) advances the hypothesis that if a structure has given rise to relatively few morphological variants, as is the case with claw structure in the Eutardigrada, then it can be judged to be very stable. Taxa recognised on the basis of differences in this structure can, therefore, be identified as evolutionary lines which have been diverging for a considerable period of time. In contrast to this situation of morphological stability allied to systematic importance, more complex structures such as the bucco-pharyngeal apparatus may not have the same phylogenetic significance; because they are complex there is a greater chance of them developing myriad minor variations in response to natural selection pressures.

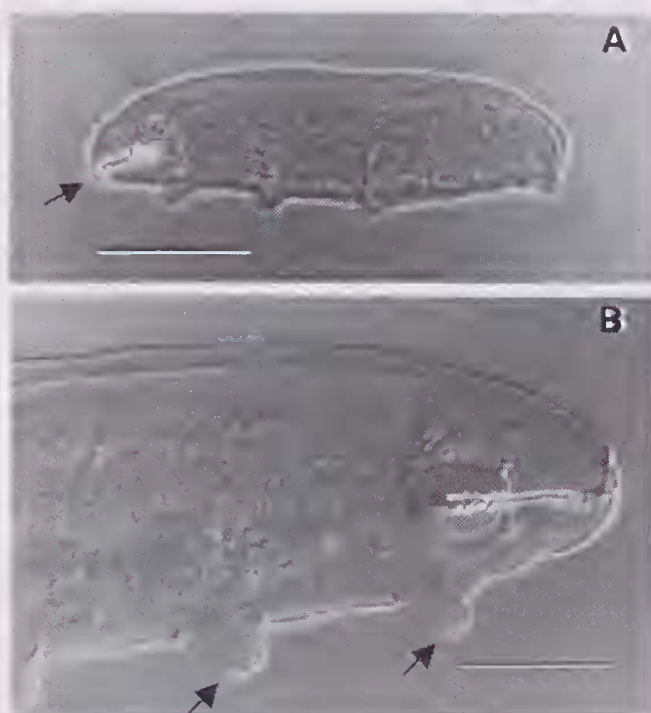


Figure 2.—A. *Apodibius serventyi* sp. nov. Paratype. Entire. Note position of mouth (arrow). Scale line 100 μ m. Phase contrast illumination. B. *Apodibius serventyi* sp. nov. Paratype. Anterior end. Note protuberances on first and second legs (arrows). Scale line 50 μ m. Nomarski illumination.

The new species *Apodibius serventyi* has been separated from the only other known representative of the genus *Apodibius* on the basis of a minor modification in the bucco-pharyngeal apparatus. Such differences are used frequently to determine species within the Eutardigrada. However, the affinities of a clawless genus in an order in which the accepted familial sub-divisions, according to Pilato (1982), are on the basis of claw structure are not readily identifiable.

In the systematic arrangement of the Eutardigrada devised by Pilato (1969 a, b, revised 1982) the order comprises four families, Macrobiotidae, Calohypsibiidae, Hypsibiidae, and Milnesiidae, plus the monotypic genus *Necopinatum* (Pilato, 1971) accorded the status incertae sedis. Within these families the claw type is characteristic and constant for each but the pattern of the bucco-pharyngeal apparatus can vary. The clawless *Apodibius* with *Macrobiotus* type bucco-pharyngeal apparatus shares possession of the latter character with genera in three families: *Doryphoribius* in the Hypsibiidae; *Haplomacrobiotus*, *Hexapodibius* and *Parahexapodibius* in the Calohypsibiidae; *Macrobiotus*, *Minibiotus*, and *Dactylobiotus* in the Macrobiotidae. Only within the Calohypsibiidae is there a tendency towards reduction of legs and claws comparable to that described for *Apodibius*. The authors support the view of Dastych (1983) that the genus *Apodibius* represents a stage of an evolutionary line along which leg and claw structure are being reduced. It is probable that with the increasing attention being paid to Tardigrada the discovery of new forms will help resolve debate about the status of *Apodibius*.

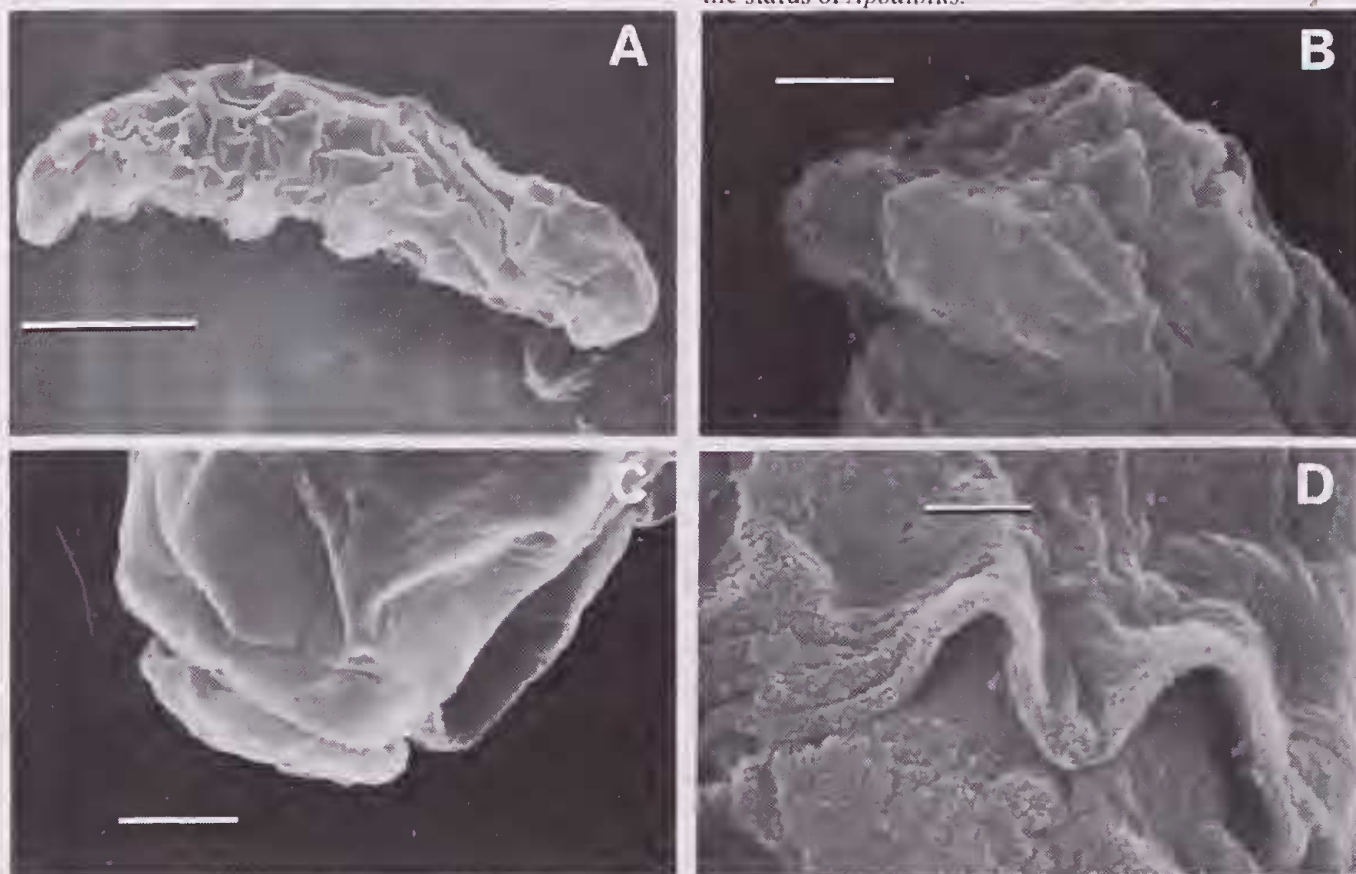


Figure 3.—SEM images* of *Apodibius serventyi* sp. nov. Paratypes.

A. Entire. Scale line 50 μ m

B. Fourth legs. Scale line 10 μ m

C. Mouth with peribuccal lamellae. Scale line 5 μ m

D. Ventral genital pore. Scale line 2.5 μ m

* Note: All SEM images produced on a JEOL 1200 EX with ASID at 80Kv. Material critical point dried and gold sputter coated.

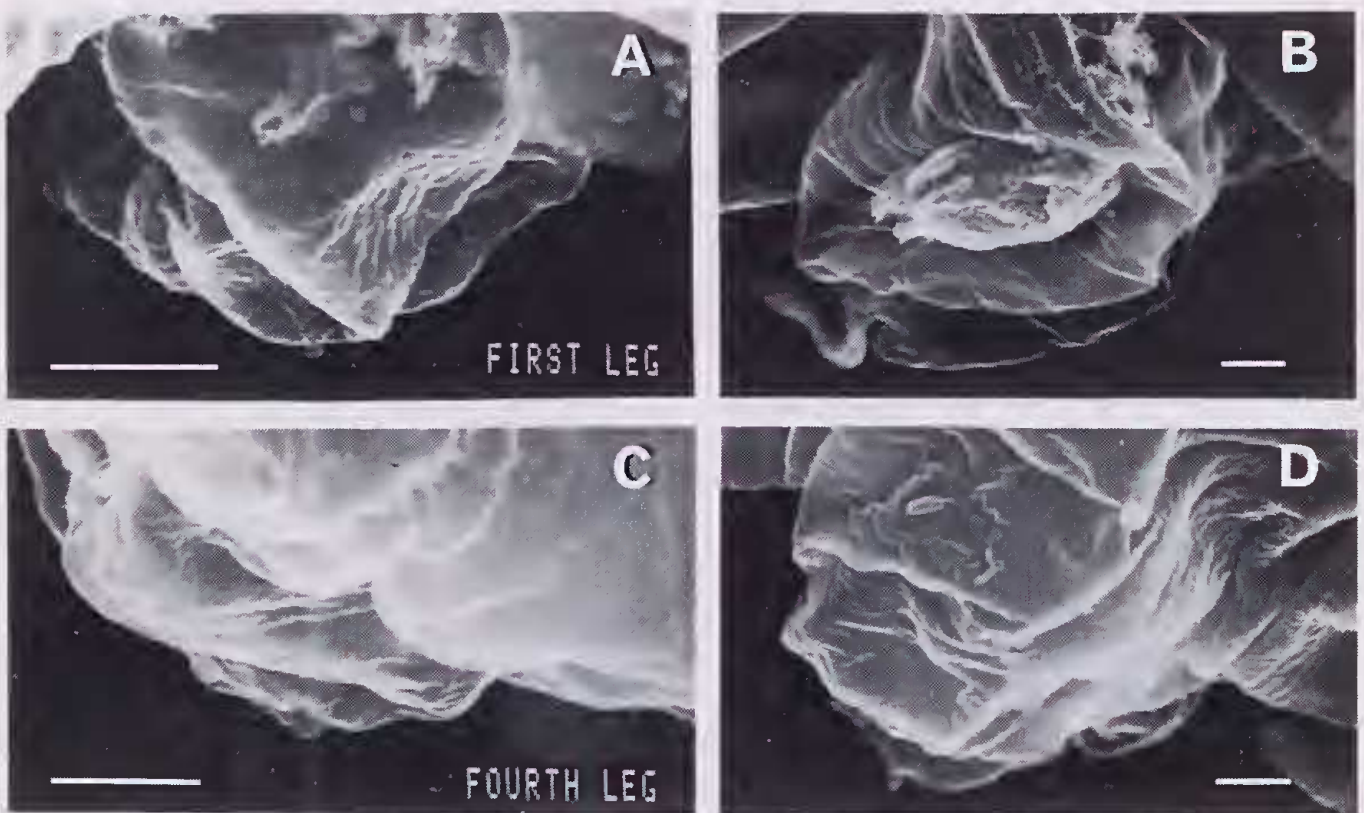


Figure 4.—SEM images of legs of *Apodibius serventyi* sp. nov. Paratype.
A. First leg B. Second leg C. Fourth leg D. Third leg
Scale line 2.5 μ m

Acknowledgments—The authors gratefully acknowledge Mr James Anderson, Department of Pathology, Glasgow Royal Infirmary for assistance in the preparation of material for scanning electron microscopy.

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